

Isotech - Stable Isotope Analysis

Determining the origin of methane

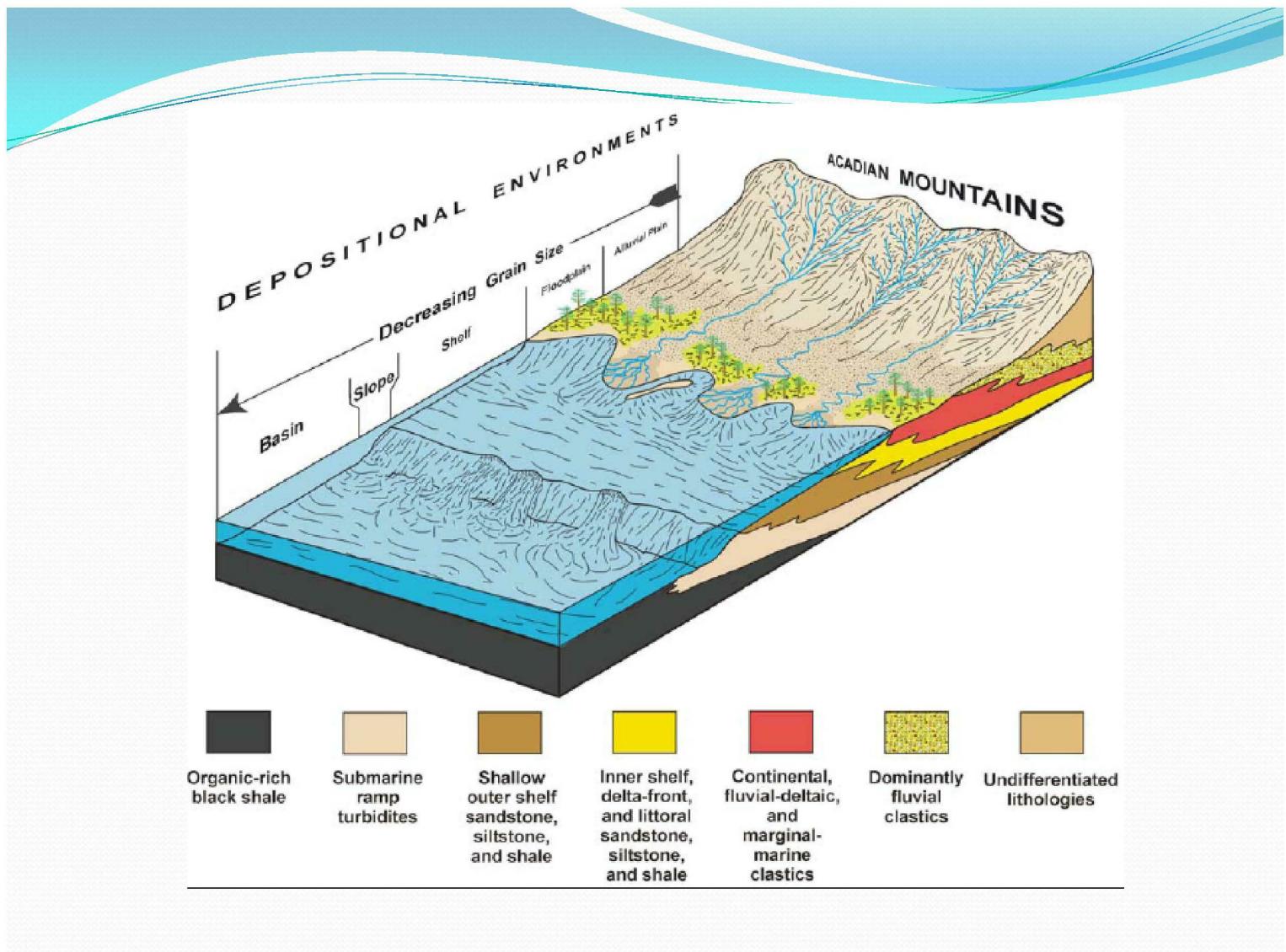
Environment of Deposition

Middle Devonian (385 MA)



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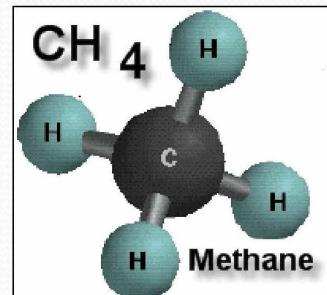
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Methane is the principal hydrocarbon detected in all stray natural gas migration incidents

- Exposure limit (gas phase): TLV-TWA: 1,000 ppm (ACGIH, 10/2009)
- Methane (CH_4) is the simplest paraffin hydrocarbon gas
- Methane is generated by microbial & thermogenic processes
- Flammable, colorless, odorless.
- Specific gravity: 0.555 (NTP) air = 1
- Explosive range: 5-15% in ambient air
- Solubility in water: 26-32 mg/l (1 atm.)
- Non toxic, no ingestion hazard
- Simple asphyxiant, explosion hazard

Methane can migrate as free gas or dissolved in the groundwater





Isotopic Balance

- Geologists trace the source of the carbon in hydrocarbons through analysis of its isotopic balance.
- Natural carbon is nearly all isotope 12, with 1.11 percent being isotope 13.
- Organic material contains less C-13, because bacteria /photosynthesis preferentially selects C-12 over C-13.
- Oil and natural gas typically show a C-12 to C-13 ratio similar to that of the biological materials from which they are to have originated.

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Delta notation

- Incident
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metamor
ratio

- The
 $\delta^{13}\text{C}$
In
Also
Uni
pair
(e.g.

$$\delta^{13}\text{C} = \frac{R_{\text{sample}} - R_{\text{reference}}}{R_{\text{reference}}}$$

Where $R = {}^{13}\text{C}/{}^{12}\text{C}$,
 $R_{\text{reference}} = \text{VPDB}$ (Vienna Pee Dee Belemnite)

$$\delta^{13}\text{C} = \delta({}^{13}\text{C}) = \delta({}^{13}\text{C}/{}^{12}\text{C}) = \frac{n_X({}^{13}\text{C})/n_X({}^{12}\text{C}) - n_{\text{ref}}({}^{13}\text{C})/n_{\text{ref}}({}^{12}\text{C})}{n_{\text{ref}}({}^{13}\text{C})/n_{\text{ref}}({}^{12}\text{C})}$$

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Isotope Geochemistry

- Molecular: Methane/Ethane
- Isotopic: Carbon and Hydrogen isotopes ($\delta^{13}\text{C}$ - CH_4 , $\delta^2\text{H}$ - CH_4 , $\delta^{13}\text{C}$ - C_2H_6)
- Noble Gases

Easily Distinguishes:

- Biogenic vs. Thermogenic (e.g. Schoell, 1983; Coleman et al, 1991; Baldassare and Laughrey, 1998)
- Distinguishing different thermogenic gases (e.g. Schoell et al, 1983; Jenden et al, 1993; Revesz et al, 2010; Tilley et al, 2010)
- What's best for distinguishing thermally mature gases?



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A N A L Y S I S R E P O R T

Lab #: 235488 Job #: 17407
 Sample Name/Number: HW02z
 Company: TechLaw, Inc.
 Date Sampled: 1/25/2012
 Container: Dissolved Gas Bottle
 Field/Site Name: A3TA
 Location:
 Formation/Depth:
 Sampling Point:
 Date Received: 2/03/2012

Component	Chemical mol. %	$\delta^{13}\text{C}$ ‰	δD ‰	$\delta^{18}\text{O}$ ‰
Carbon Monoxide -----	nd			
Hydrogen Sulfide -----	na			
Helium -----	0.0112			
Hydrogen -----	nd			
Argon -----	0.628	-29		
Oxygen -----	0.80			
Nitrogen -----	40.72			
Carbon Dioxide -----	0.094			
Methane -----	57.06	-29.30	-160.6	
Ethane -----	0.687			
Ethylene -----	nd			
Propane -----	nd			
Propylene -----	0.0001			
Iso-butane -----	nd			
N-butane -----	nd			
Iso-pentane -----	nd			
N-pentane -----	nd			
Hexanes + -----	nd			
Water -----		-64.6	-9.66	

-29

-160

% argon

% carbon 13

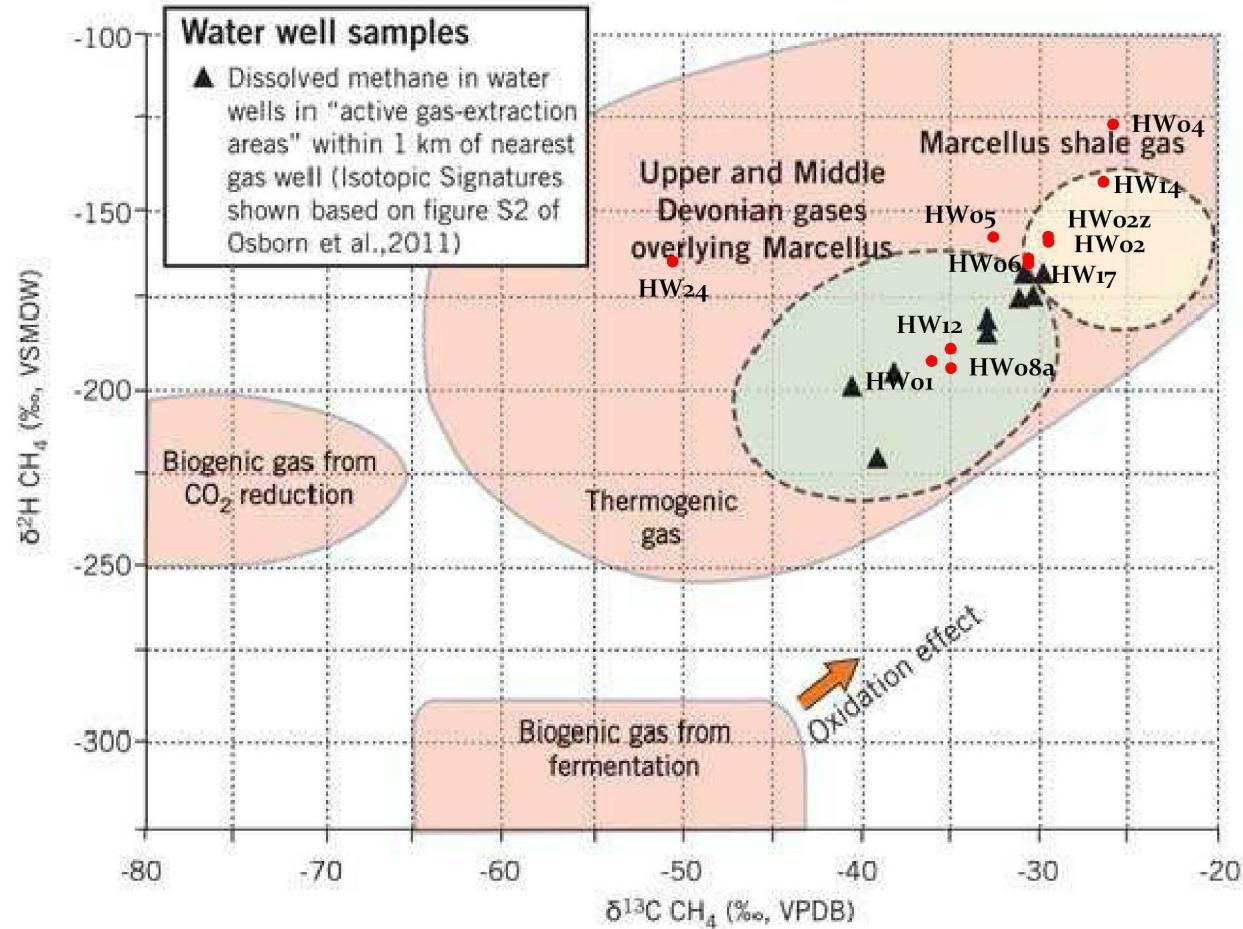
% deuterium

% oxygen 18

% nitrogen

Total BTU/cu.ft. dry @ 60deg F & 14.7psia, calculated: 590

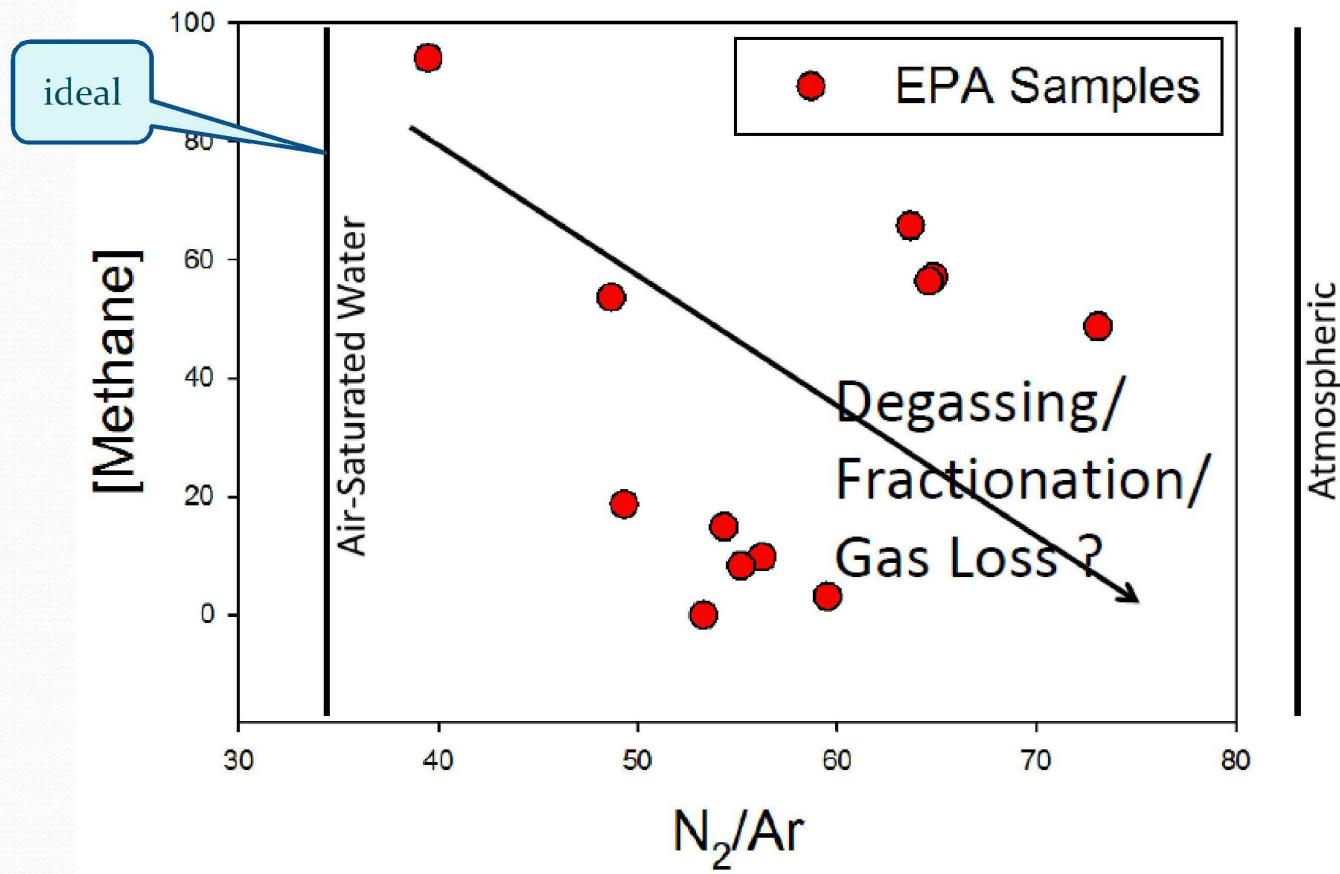
Specific gravity, calculated: 0.736

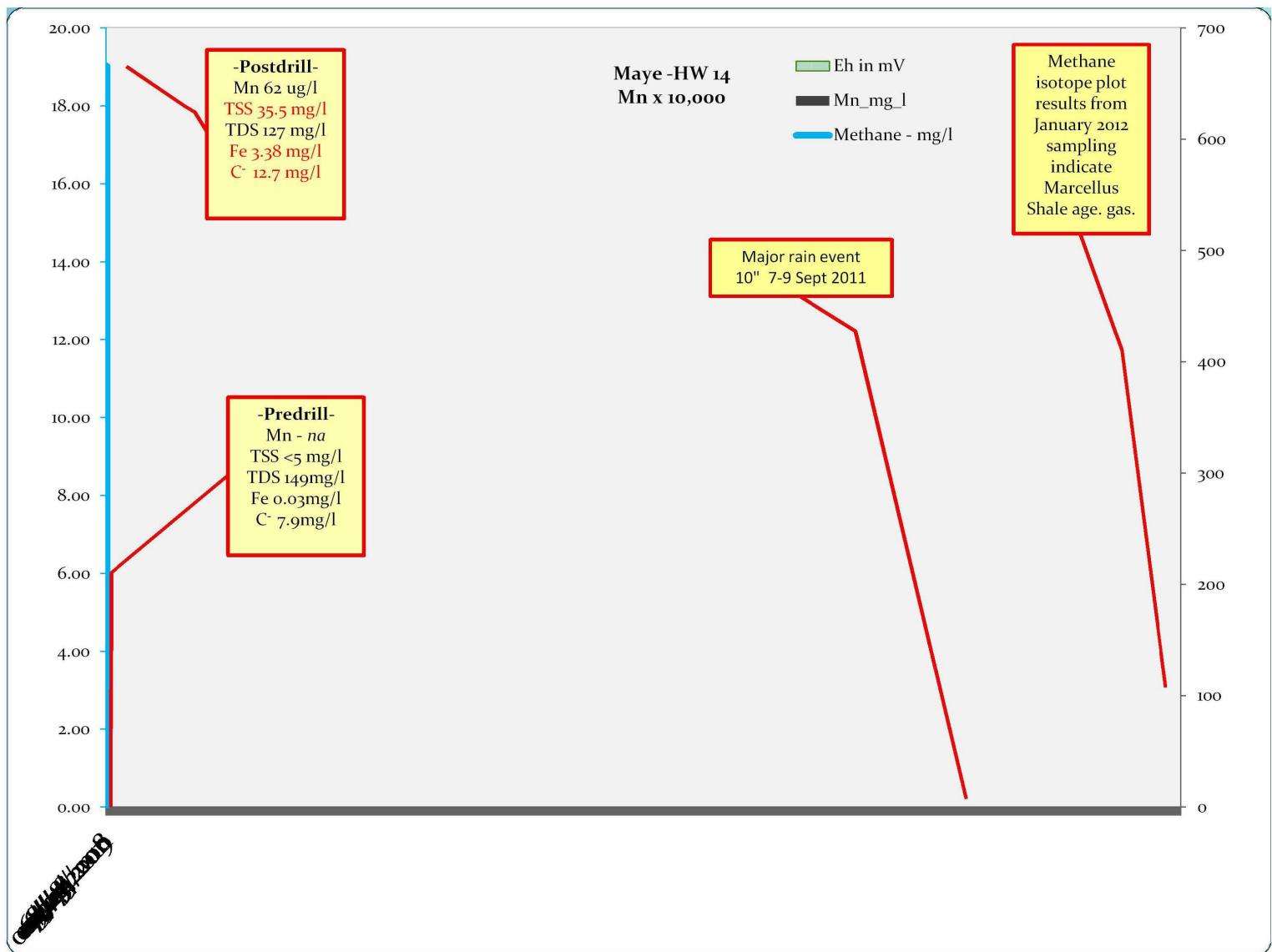


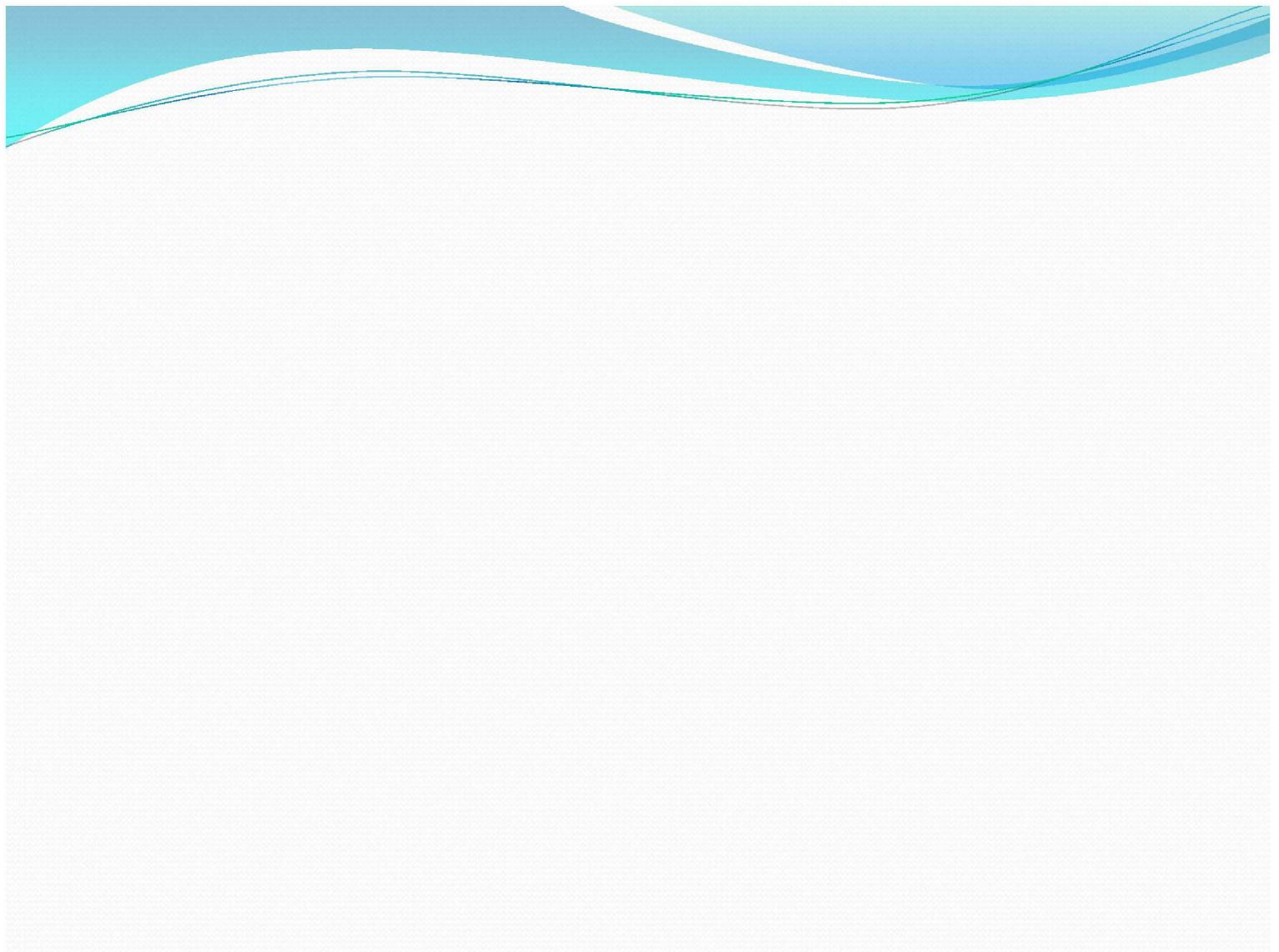
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Sample Quality - degassing?







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